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ABSOLUTE ROTARY ENCODER WITH CANOPEN INTERFACE
USER MANUAL

CANopen

Main Features

- Compact and heavy-duty industrial design
- Interface: CANopen (DS406)
  CANopen Lift (DSP417)
- Housing: 36 mm ∅
- Solid shaft: 6 or 10mm∅
- Blind hollow shaft: 6mm∅
- Max. 4096 steps per revolution (12 Bit)
- Max. 65536 revolutions (16 Bit)
- Code: Binary
- Velocity and Acceleration Output
- LSS services

Mechanical Structure

- Aluminium flange and housing
- Nickel-plated steel housing
  Stainless steel shaft
  Precision ball bearings

Programmable Parameters

- Direction of rotation (complement)
- Resolution per revolution
- Total resolution
- Preset value
- Two limit switches and eight cams
- Baud rate and CAN-identifier
- Transmission mode: Polled mode, cyclic mode, sync mode

Electrical Features

- Highly integrated circuit in SMD-technology
- Polarity inversion protection
- Over-voltage-peak protection
- Galvanic Isolation

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CANOPEN

Table of Contents

Main Features 1
Mechanical Structure 1
Programmable Parameters 1
Electrical Features 1
Table of Contents 2
General Security Advise 4
About this Manual 4
1. Introduction 5
1.1 General CANopen Information 5
2. Installation 7
2.1 Electrical Connection 7
3. Technical Data 9
Electrical Data 9
Sensor data 9
Tab. 3 Sensor data 9
Flange 10
Synchro (S) 10
Blind hollow shaft (B) 10
Clamp (C) 10
Minimum Mechanical Lifetime 10
Cable 10
4. Configuration 11
4.1 Operating Modes 11
4.1.1 General 11
4.1.2 Mode: Preoperational 11
4.1.3 Mode: Start - Operational 11
4.1.4 Mode: Stopped 11
4.1.2 Reinitialization of the Encoder 12
4.2 Normal Operating 12
4.3 Storing Parameter 13
4.3.1 List of storable Parameter 13
4.3.1 Storing Procedure 13
4.4 Restoring Parameters 14
4.5 Usage of Layer Setting Services (LSS) 14
5. Programmable Parameters 15
5.1 Programming example: Preset Value 16
5.1.1 Set Encoder Preset Value 16
5.2 Communication Profile DS301 specific objects from 1000h - 1FFFh 17
5.3 Manufacturer specific objects 2000h – 5FFFh 18
5.4 Application specific objects 6000h – 67FEh 18
5.5 Object Descriptions 19
Object 1000h: Device Type 19
Object 1001h: Error Register 20
Object 1003h: Pre-Defined Error Field 20
Object 1005h: COB-ID Sync 21
Object 1008h: Manufacturer Device Name 21
Object 1009h: Manufacturer Hardware Version 21
Object 100Ah: Manufacturer Software Version 21
Object 100Ch: Guard Time 22
Object 100Dh: Life Time Factor 22
Object 1010h: Store Parameters 22
Object 1011h: Restore Parameters 23
Object 1012h: COB-ID Time Stamp Object 23
Object 1013h: High Resolution Time Stamp 23
Object 1014h: COB-ID Emergency Object 24
Object 1016h: Consumer Heartbeat Time 24
Object 1017h: Producer Heartbeat Time 24
Object 1018h: Identity Object 25
Object 1020h: Verify configuration 25
Object 1029h: Error behaviour 25
Object 1800h: 1st Transmit PDO Communication Parameter 26
Object 1801h: 2nd Transmit PDO Communication Parameter 26
Event Timer 27
Object 1A00h: 1st Transmit PDO Mapping Parameter 27
Object 1A01h: 2nd Transmit PDO Mapping Parameter 28
Object 1F50h: Download Program Area 28
Object 1F51h: Program Control 28
Object 2000h: Position Value 29
Object 2100h: Operating Parameters 29
Object 2101h: Resolution per Revolution 30
Object 2102h: Total Resolution 30
Object 2103h: Preset Value 31
Object 2104h: Limit Switch, min. 31
Object 2105h: Limit Switch, max. 32
Object 2160h: Customer storage 32
Object 2200h: Cyclic Timer PDO 33

Object 2300h: Save Parameter with Reset 33
Object 3000h: Node Number 33
Object 3001h: Baudrate 34
Object 3010h: Speed Control 34
Object 3011h: Speed Value 34
Object 3020h: Acceleration Control 35
Object 3021h: Acceleration Value 35
Object 4000h: Bootloader Control 35
Object 6000h: Operating parameters 36
Object 6001h: Measuring units per revolution 37
Object 6002h: Total measuring range in measuring units 37
Object 6003h: Preset value 37
Object 6004h: Position value 37
Object 6030h: Speed Value 38
Object 6040h: Acceleration Value 38
Object 6200h: Cyclic timer 38
Object 6300h: Cam state register 39
Object 6301h: Cam enable register 39
Object 6302h: Cam polarity register 39
Object 6400h: Area state register 42
Object 6401h: Work area low limit 43
Object 6402h: Work area high limit 43
Object 6500h: Operating status 43
Object 6501h: Single-turn resolution 44
Object 6502h: Number of distinguishable revolutions 44
Object 6503h: Alarms 44
Object 6504h: Supported alarms 45
Object 6505h: Warnings 45
Object 6506h: Supported warnings 46
Object 6507h: Profile and software version 46
Object 6508h: Operating time 46
Object 6509h: Offset value 47
Object 650Ah: Module identification 47
Object 650Bh: Serial number 47
6. Diagnosis 48
6.2 Troubleshooting 48
7. Mechanical Drawings 49
Appendix A: Order Codes 52
Appendix B: History 53
Appendix C: Glossary 54
Appendix D: List of tables 57
Appendix E: Document history 57

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General Security Advise

Important Information
Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

Please Note
Electrical equipment should be serviced only by qualified personnel. No responsibility is assumed by POSITAL for any consequences arising out of the use of this material. This document is not intended as an instruction manual for untrained people.

About this Manual

Background

This user manual describes how to install and configure an MCD absolute rotary encoder with CANopen interface.

Relate Note

Version date: 03. February 2008
Version number: 02/09
Reference number: UKE20090203

Imprint

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CANOPEN

1. Introduction

This manual explains how to install and configure the MAGNETOCODE absolute rotary encoder with CANopen interface applicable for both military and industrial applications with CANopen interface. The products are fully compliant with standard DS406.

Measuring System

Magnetic rotary encoder determine positions using the Hall effect sensor technology developed for the automotive mass market. A permanent magnet fixed to the shaft generates a magnetic field that is sampled by the Hall sensor, which translates the measured value into a unique absolute position value.

To register revolutions even when no voltage is applied, energy from the turning of the shaft must suffice for proper operation. An innovative, patented technology makes this feasible even at low rotational speeds and through long standstill periods – a Wiegand wire ensures that the magnetic field can only follow the turning of the shaft in discrete steps. A coil wound on the Wiegand wire receives only brief, strong voltage spikes, which prompt the reliable recognition of each revolution.

Typical Applications:

- Packing Machines
- Mobile Machines
- Wind Mills
- Medical Equipment

1.1 General CANopen Information

The CANopen system is used in industrial applications. It is a multiple access system (maximum: 127 participants), which means that all devices can access the bus. In simple terms, each device checks whether the bus is free, and if it is the device is able to send messages. If two devices try to access the bus at the same time, the device with the higher priority level (lowest ID number) has permission to send its message. Devices with the lowest priority level must delay their data transfer and wait before retrying to send their message. Data communication is carried out via messages. These messages consist of 1 COB-ID followed by a maximum of 8 bytes of data. The COB-ID, which determines the priority of the message, consists of a function code and a node number. The node number corresponds to the network address of the device. It is unique on a bus. The function code varies according to the type of message being sent:

- Management messages (LMT, NMT)
- Messaging and service (SDOs)
- Data exchange (PDOs)
- Layer Setting Services (LSS)
- Predefined messages (synchronization, emergency messages)

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The absolute rotary encoder supports the following operating modes:

- Polled mode: The position value is only sent on request.
- Cyclic mode: The position value is sent cyclically (regular, adjustable interval) on the bus.
- SYNC mode: The position value is sent after a synchronization message (SYNC) is received. The position value is sent every n SYNCs (n ≥ 1).

Other functions (offset values, resolution, etc) can be configured. The absolute rotary encoder corresponds to the class 2 encoder profile (DS 406 in which the characteristics of encoder with CANopen interface are defined). The node number and speed in bauds are determined by their corresponding object dictionary entries.

The transmission speed can range from 20kBaud up to 1Mbaud (30m cable for a maximum speed of 1Mbaud, 1000m cable for a maximum speed of 20 kbaud). Various software tools for configuration and parameter-setting are available from different suppliers. It is easy to align and program the rotary encoders using the EDS (electronic data sheet) configuration file provided.

Further information is available at:

CAN in Automation (CiA) International Users and Manufacturers Group e.V.
Kontumazgarten 3
DE-90429 Nurenberg

(*) Reference: CAN Application Layer for Industrial Applications
CiA Draft Standard 201 ... 207, Version 1.1
CAL-based Communication Profile for Industrial Systems
CiA Draft Standard 301
CiA Draft Standard 305 Layer Setting Services
CiA Draft Standard 406 Device Profile for Encoders

Note: All datasheets and manuals can be downloaded for free from our website www.posital.eu

We do not assume responsibility for technical inaccuracies or omissions. Specifications are subject to change without notice.

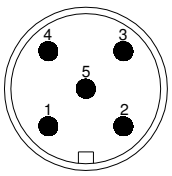
2. Installation

2.1 Electrical Connection

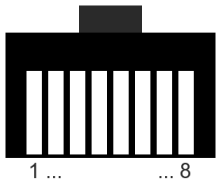
Function	Wire end	Connector Pin RJ45	Connector Pin M12
Can High	white	1	4
Can Low	brown	2	5
Can-GND	green	3	1
GND	yellow	4	3
+ U_b= 10-30 V	red	8	2

Tab.1 Signal Assignment Connector / Cable

5 pin male M12 connector



RJ45 Connector



Setting Node Number via SDO Objects

The node number has to be adjusted via SDO objects. The default node number is 32. To set the node number, object 3000h has to be written. For further information regard chapter 5.5 Object Dictionary.

Setting Baud Rate via SDO Objects

The baud rate has to be adjusted via SDO objects. The default baud rate is 20 kBaud. To set baud rate object 3001h has to be written. For further information please regard chapter 5.5 Object Dictionary.

Setting Node Number via LSS

The node number can also be adjusted via Layer Setting Services (LSS). For further information regard chapter 4.5

Setting Baud Rate via LSS

The baud rate can also be adjusted via Layer Setting Services (LSS). The default baud rate is 20 kBaud. For further information regard chapter 4.5.

Bus Termination

If the encoder is the last device in the bus you can use an external termination resistor on a T-coupler.

3. Technical Data

In the following section you will find general technical data about MCD absolute rotary encoders with CANopen interface.

Electrical Data

Interface	Transceiver according ISO 11898, galvanically isolated by opto-couplers
Transmission rate	max. 1 MBaud
Device addressing	Adjustable by SDO telegrams or Layer Setting Services
Supply voltage	10 – 30* V DC (absolute limits)
Current consumption	max. 100 mA with 10 V DC, max. 50 mA with 24 V DC
Power consumption	max. 1,2 Watts
EMC	Emitted interference: EN 61000-6-4
	Noise immunity: EN 61000-6-2
Electrical lifetime	> 10^5 h

Tab. 2 Electrical Data

*Absolute rotary encoders should be connected only to subsequent electronics whose power supplies comply with EN 50178 (protective low voltage)

Sensor data

Singleturn technology	magnetic 2 axis Hall sensor
Singleturn resolution	up to 4096 steps / revolution (12 Bit)
Singleturn accuracy	+/-0,35°
Internal cycle time	< 1 **m**s
Multiturn technology	self supplied magnetic pulse counter
Multiturn resolution	Can measure up to 200 Billion revolutions

Tab. 3 Sensor data

Environmental Conditions

Operating temperature	- 30 ... + 85 °C (M12 connector version - 30 ... + 70 °C (Cable exit version) *
Storage temperature	- 30 ... + 85 °C (M12 connector version - 30 ... + 70 °C (Cable exit version) *
Humidity	98 % (without liquid state)
Protection Class (EN 60529)	Casing side: IP54 (Cable exit version) IP65 (M12 Connector version)
	Shaft side: IP65

Tab.4 Environmental Conditions

Mechanical Data

Housing	Nickel-plated iron housing
Flange	Aluminium
Shaft	Stainless steel
Lifetime	Dependent on shaft version and shaft loading – refer to table
Max. shaft loading	Axial 40 N, radial 110 N
Inertia of rotor	≤ 30 gcm^2
Friction torque	≤ 3 Ncm
RPM (continuous operation)	max. 12.000 RPM
Shock (EN 60068-2-27)	≤ 100 g (half sine, 6 ms)
Permanent shock (EN 60028-2-29)	≤ 10 g (half sine, 16 ms)
Vibration (EN 60068-2-6)	≤ 10 g (10 Hz ... 1,000 Hz)
Weight (standard version)	≈ 150 g, including cable

Flange	**Synchro (S)**	**Blind hollow shaft (B)**	**Clamp (C)**
Shaft diameter	6 mm	6 mm	10 mm
Shaft length	11,5 mm	-	20 mm-
Hollow shaft depth min. / max.	-	8 mm / 18 mm	-

Tab. 5 Mechanical data

Minimum Mechanical Lifetime

Flange	Lifetime in 10^8 revolutions with F_a / F_r		
	40 N / 60 N	40 N / 80 N	40 N / 110 N
S06 (Synchro flange 6 x 11.5)	216	91	35

Tab. 6 Minimum Mechanical Lifetime

Cable

Operating temperature cable	flexing -5°C bis +70°C static -30°C bis +70°C
Minimum bend radius	flexing 10x cable diameter static 5x cable diameter
Cable	aprox 6 mm ∅ / type : LIYCY 4x2x0.14

Tab.7 Cable properties

4. Configuration

The purpose of this chapter is to describe the configuration parameters of the absolute rotary encoder with CANopen interface.

4.1 Operating Modes

4.1.1 General

The encoder accesses the CAN network after powerup in pre-operational mode:
BootUp Message: 700 hex + Node Number

It is recommended that the parameters can be changed by the user when the encoder is in preoperational mode. Pre-operational mode entails reduced activity on the network, which simplifies the checking of the accuracy of the sent/received SDOs. It is not possible to send or receive PDOs in pre-operational mode.

4.1.2 Mode: Preoperational

To set a node to pre-operational mode, the master must send the following message:

Identifier	Byte 0	Byte 1	Description
0 h	80 h	00	NMT-PreOp, all nodes
0 h	80 h	NN	NMT-PreOp, NN

NN: node number
It is possible to set all nodes (Index 0) or a single node (Index NN) to pre-operational mode.

4.1.3 Mode: Start - Operational

To put one or all nodes in the operational state, the master have to send the following message:

Identifier	Byte 0	Byte 1	Description
0 h	01 h	00	NMT-Start, all nodes
0 h	01 h	NN	NMT-Start, NN

NN: node number
It is possible to set all nodes (Index 0) or a single node (Index NN) to operational mode.

4.1.4 Mode: Stopped

To put one or all nodes in the stopped state, the master have to send the following message:

Identifier	Byte 0	Byte 1	Description
0 h	02 h	00	NMT-Stop, all nodes
0 h	02 h	NN	NMT-Stop, NN

NN: node number

It is possible to set all nodes (Index 0) or a single node (Index NN) to stop mode.

4.1.2 Reinitialization of the Encoder

If a node is not operating correctly, it is advisable to carry out a reinitialization:

NN	Command	Index	Description
0 h	82 h	00	Reset Communication
0 h	81 h	NN	Reset Node

NN: node number

It is possible to set all nodes (Index 0) or a single node (Index NN) in reset mode.

After reinitialization, the encoder accesses the bus in pre-operational mode.

4.2 Normal Operating

Polled Mode	By a remote-transmission-request telegram the connected host calls for the current process value. The encoder reads the current position value, calculates eventually set-parameters and sends back the obtained process value by the same identifier.
Cyclic Mode	The encoder transmits cyclically - without being called by the host - the current process value. The cycle time can be programmed in milliseconds for values between 1 ms and 65536 ms.
Sync Mode	After receiving a sync telegram by the host, the encoder answers with the current process value. If more than one node number (encoder) shall answer after receiving a sync telegram, the answer telegrams of the nodes will be received by the host in order of their node numbers. The programming of an offset-time is not necessary. If a node should not answer after each sync telegram on the CAN network, the parameter sync counter can be programmed to skip a certain number of sync telegrams before answering again.

Tab. 8 CAN Transmission Mode Description

4.3 Storing Parameter

4.3.1 List of storable Parameter

Object Index	Object Description
1005h	COB-ID Sync
100Ch	Guard Time
100Dh	Life Time Factor
1016h	Consumer Heartbeat Time
1017h	Producer Heartbeat Time
1020h	Verify configuration
1800h	Communication parameter PDO 1
1801h	Communication parameter PDO 2
1A00h	Transmit PDO1 Mapping Parameter
1A01h	Transmit PDO2 Mapping Parameter
2100h	Operating Parameters
2101h	Resolution per Revolution
2102h	Total Resolution
2103h	Preset Value
2104h	Limit Switch, min.
2105h	Limit Switch, max.
2160h	Customer Storage
2200h	Cyclic Timer
3000h	Node Number
3001h	Baud rate
6000h	Operating Parameter
6001h	Steps per Revolution
6002h	Total Resolution
6003h	Preset Value
6200h	Cyclic Timer

Tab. 9 List of Storable Parameters

4.3.1 Storing Procedure

The parameter settings can be stored in a non-volatile E^2PROM. The parameter settings are stored in RAM when being programmed. When all the parameters are set and proved,

they can be transferred in one burn cycle to the E^2PROM by the parameter memory transfer. The stored parameters are copied after a RESET (Power on, NMT-Reset) from the E^2PROM to the RAM (volatile memory).

Storing without Reset

By using the object 1010h from the communication profile related object dictionary you can store the parameters into the non-volatile memory without a reset.

Storing with Reset

By using the object 2300h from the manufacturer specific object dictionary you can store the parameters into the non-volatile memory. After storing the parameters a reset of the device is performed.

4.4 Restoring Parameters

The default parameters can be restored by using the object 1011h from communication profile related object dictionary. The already in the non-volatile memory programmed parameters are not overwritten. Only after a new store command the default parameters are stored in the non-volatile memory. To restore the default parameter the following telegram is used. The restored parameters are equal for every type of CANopen encoder and might not fit with the status after delivery. Please check the restored parameters before you store them to the non-volatile memory.

4.5 Usage of Layer Setting Services (LSS)

To configure the encoder via LSS the encoder will be the LSS slave device and the control has to support LSS master device functionality.
The LSS master device requests services, that are performed by the LSS slave devices (encoder). The LSS master device requests the LSS address (vendor-id, product-code, revision-number, serial-number) from the LSS slave device. After receiving this information the control can unequivocally identify the encoder and the node number and baud rate can be set.

5. Programmable Parameters

Objects are based on the CiA 406 DS V3.2: CANopen profile for encoders (www.can-cia.org)

Command	Function	Telegram	Description
22h	Domain Download	Request	Parameter to Encoderr
23h, 27h, 2Bh, 2Fh (*)	Domain Download	Request	Parameter to Encoder (Bytes indicated)
60h	Domain Download	Confirmation	Parameter received
40h	Domain Upload	Request	Parameter request
43h, 47h, 4Bh, 4Fh (*)	Domain Upload	Reply	Parameter to Master (Bytes indicated)
80 h	Warning	Reply	Transmission error

Tab. 10 General Command Byte Description

(*)The value of the command byte depends on the data length of the called parameter:

Command	Data length	Data type		Command	Data length	Data type
43h	4 Byte	Unsigned 32		23h	4 Byte	Unsigned 32
47h	3 Byte	Unsigned 24		27h	3 Byte	Unsigned 24
4Bh	2 Byte	Unsigned 16		2Bh	2 Byte	Unsigned 16
4Fh	1 Byte	Unsigned 8		2Fh	1 Byte	Unsigned 8

Tab. 11 Detailed Command Byte Description

Object Dictionary

The data transmission according to CAL is realized exclusively by object oriented data messages. The objects are classified in groups by an index record. Each index entry can be subdivided by sub-indices. The overall layout of the standard object dictionary is shown beside:

Index (hex)	Object
0000	not used
0001-001F	Static Data Types
0020-003F	Complex Data Types
0040-005F	Manufacturer Specific Data Types
0060-0FFF	Reserved for further use
1000-1FFF	Communication Profile Area
2000-5FFF	Manufacturer Specific Profile Area
6000-9FFF	Standardized Device Profile Area
A000-FFFF	Reserved for further use

Tab. 12 Overview Object Dictionary

5.1 Programming example: Preset Value

If a CANopen device is connected and configured with the right baudrate and also configured to a unused node number, it will start up into the pre-operational mode and send a bootup massage to the master.

5.1.1 Set Encoder Preset Value

Master to Encoder with Node Number 1

Setting Preset Value (Value 1000)

Identifier	DLC	Command	Index		Subindex	Service/Process data			
NN 1		Download	6003h			Byte 4	Byte 5	Byte 6	Byte 7
601	8	22	03	60	00	00	10	00	00

Answer of the Encoder

Identifier	DLC	Command	Index		Subindex	Service/Process data			
NN 1		Download	6003h			Byte 4	Byte 5	Byte 6	Byte 7
581	8	43	03	60	00	00	00	00	00

Read Preset Value from the Encoder

Identifier	DLC	Command	Index		Subindex	Service/Process data			
NN 1		Download	6003h			Byte 4	Byte 5	Byte 6	Byte 7
601	8	40	03	60	00	00	00	00	00

Answer of the Encoder

Identifier	DLC	Command	Index		Subindex	Service/Process data			
NN 1		Download	6003h			Byte 4	Byte 5	Byte 6	Byte 7
581	8	43	03	60	00	00	10	00	00

Save Preset Values

Identifier	DLC	Command	Index		Subindex	Service/Process data			
NN 1		Download	1010h			Byte 4	Byte 5	Byte 6	Byte 7
601	8	22	10	10	01	73	61	76	65

5.2 Communication Profile DS301 specific objects from 1000h - 1FFFh

In this manual we refer to the communication profile DS301 V4.02

Object	Description	Page Hand-Book	Page DS301	Page DS406
1000h	Device type	22	86	8
1001h	Error register	22	87	8
1003h	Pre-defined error field	22	88	
1005h	COB-ID SYNC-message	23	89	
1006h	ComCyclePeriode	23	90	
1008h	Device name	24	91	
1009h	Hardware version	24	91	
100Ah	Software version	24	91	
100Ch	Guard Time	24	92	
100Dh	Life Time Factor	24	92	
1010h	Store parameters	25	92	
1011h	Restore default parameters	25	94	
1012h	COB-ID Time Stamp	26	97	
1013h	High Resolution Time Stamp	26	98	
1014h	COB-ID Emergency	26	98	
1016h	Consumer Heartbeat Time	26	100	
1017h	Producer Heartbeat Time	27	101	
1018h	Identity Object	27	101	
1020h	Verify Configuration		117	
1029h	Error Behaviour		133	9
1800h	Communication parameter PDO 1	28	111	9
1801h	Communication parameter PDO 2	28	111	11
1A00h	Transmit PDO1 Mapping Parameter	30	112	11
1A01h	Transmit PDO2 Mapping Parameter	30	112	12
1F50h	Download Program Area			
1F51h	Program Control			

Tab. 13 Object Dictionary 1000h-1FFFh

5.3 Manufacturer specific objects 2000h – 5FFFh

Object	Description	Page Hand-Book
2000h	Position Value	31
2100h	Operating Parameters	31
2101h	Resolution per Revolution	31
2102h	Total Resolution	33
2103h	Preset Value	34
2104h	Limit Switch, min.	34
2105h	Limit Switch, max.	33
2160h	Customer Storage	35
2200h	Cyclic Timer	35
2300h	Save Parameter with reset	35
3000h	Node Number	36
3001h	Baudrate	36
3010h	Speed Control	37
3011h	Speed Value	37
3020h	Acceleration Control	37
3021h	Acceleration Value	37
4000h	Bootloader Control	38

Tab. 14 Object Dictionary 2000-5FFF

5.4 Application specific objects 6000h – 67FEh

In this manual we refer to the communication profile DS406 V3.2

Object	Description	Page Hand-Book	Page DS406
6000h	Operating Parameters	38	17
6001h	Measuring units per revolution	38	18
6002h	Total measuring range in measuring units	39	19
6003h	Preset value	39	19
6004h	Position Value	40	20
6030h	Speed Value	40	25
6040h	Acceleration Value	40	26
6200h	Cyclic Timer	40	28
6300h	Cam state register	40	30

6301h	Cam enable register	41	32
6302h	Cam polarity register	41	33
6400h	Area state register	44	
6401h	Work area low limit	44	
6402h	Work area high limit	44	
6500h	Operating status	45	63
6501h	Single-turn resolution	45	64
6502h	Number of distinguishable revolutions	45	65
6503h	Alarms	46	65
6504h	Supported alarms	46	66
6505h	Warnings	47	67
6506h	Supported warnings	47	68
6507h	Profile and software version	48	69
6508h	Operating time	48	70
6509h	Offset value	49	70
650Ah	Module identification	49	71
650Bh	Serial number	49	72

Tab. 15 Object Dictionary 6000h-6FFFh

5.5 Object Descriptions

In the following chapter you will find detailed information of the object dictionary related to the encoder device.

Object 1000h: Device Type

The object at index 1000h describes the type of device and its functionality. It is composed of a 16-bit field which describes the device profile that is used and a second 16-bit field which gives additional information about optional functionality of the device. The additional information parameter is device profile specific.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 32	N/A	ro	no

MCD absolute rotary encoder single turn: 10196h

MCD absolute rotary encoder multi turn: 20196h

Object 1001h: Error Register

This object is used by the device to display internal faults. When a fault is detected, the corresponding bit is therefore activated.

The following errors are supported:

Bit	Description	Comments
0	Generic Error	The generic error is signaled at any error situation.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 8	N/A	ro	no

Object 1003h: Pre-Defined Error Field

The object holds the errors that have occurred on the device and have been signaled via the Emergency Object.

- The error code is located in the least significant word
- Additional Information is located in the most significant word
- Subindex 0 contains the number of recorded errors

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of recorded errors	Unsigned 8	0	rw	no
1	Most recent errors	Unsigned 32	-	ro	no
2	Second to last error	Unsigned 32	-	ro	no
…					
10					

Clearing Error Log

The error log can be cleared by writing 0 to subindex 0 of object 1003.

Object 1005h: COB-ID Sync

This object contains the synchronization message identifier.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 32	80000080h	rw	no

Object 1008h: Manufacturer Device Name

This object contains the device name.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	String	-	ro	no

Object 1009h: Manufacturer Hardware Version

This object contains the article name of the circuit board.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	String	-	ro	no

There is one actual version of circuit boards for MCD:

- POS033 (MCD-CA)

Object 100Ah: Manufacturer Software Version

This object contains the manufacturer software version. The new encoder line 2008 starts with version 4.00.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	String	4.00	ro	no

Object 100Ch: Guard Time

This object contains the guard time in milliseconds.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 16	0	rw	yes

Object 100Dh: Life Time Factor

This object contains the life time factor parameters. The life time factor multiplied with the guard time gives the life time for the node guarding protocol.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 8	0	rw	yes

Object 1010h: Store Parameters

This object is used to store device and CANopen related parameters to non volatile memory.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	2	ro	no
1	Store all parameters	Unsigned 32	“save”	rw	no

Storing procedure

To save the parameters to non volatile memory the access signature “save” has to be sent to the corresponding subindex of the device.

	Most significant word		Least significant word	
ASCII	E	v	a	s
Hex value	65h	76h	61h	73h

Object 1011h: Restore Parameters

This object is used to restore device and CANopen related parameters to factory settings.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	2	ro	no
1	Restore all parameters	Unsigned 32	“load”	rw	no

Storing procedure

To save the parameters to non volatile memory the access signature “load” has to be sent to the corresponding subindex of the device.

	Most significant word		Least significant word	
ASCII	D	a	o	l
Hex value	64h	61h	6Fh	6Ch

Note: The restoration of parameters will only be taken into account after a power up or reset command. Please check all parameters before you store them to the non volatile memory.

Object 1012h: COB-ID Time Stamp Object

This object contains the COB-ID of the Time Stamp object.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 32	100h	rw	no

Object 1013h: High Resolution Time Stamp

This object contains a time stamp with a resolution of 1µs.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 32	0	rw	no

Object 1014h: COB-ID Emergency Object

This object contains the EMCY emergency message identifier.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 32	80h + Node ID	rw	no

Object 1016h: Consumer Heartbeat Time

The consumer heartbeat time defines the expected heartbeat cycle time in ms. The device can only monitor one corresponding device. If the time is set to 0 the monitoring is not active. The value of this object must be higher than the corresponding time (object 1017) of the monitored device.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of indices	Unsigned 8	1	ro	no
1	Consumer heartbeat time	Unsigned 32	0	rw	yes

The context of subindex 1 is as follows:

Bit	31 to 24	23 to 16	15 to 0
Value	0h (reserved)	Address of monitored device	Monitoring time (ms

Object 1017h: Producer Heartbeat Time

The object contains the time intervall in milliseconds in which the device has to produce the a heartbeat message.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	-	Unsigned 16	0	rw	yes

Object 1018h: Identity Object

This object contains the device information.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of entries	Unsigned 8	4	ro	no
1	Vendor ID	Unsigned 32	42h	ro	no
2	Product Code	Unsigned 32		ro	no
3	Revision Number	Unsigned 32	10000h	ro	no
4	Serial Number	Unsigned 32		ro	no

Object 1020h: Verify configuration

This object indicates the downloaded configuration date and time.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of entries	Unsigned 8	2h	ro	no
1h	Configuration date	Unsigned 32		rw	no
2h	Configuration time	Unsigned 32		rw	no

Object 1029h: Error behaviour

This object indicates the error behavior.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of entries	Unsigned 8	1h	ro	no
1h	Communication error	Unsigned 8		rw	no

Object 1800h: 1st Transmit PDO Communication Parameter

This object contains the communication parameter of the 1st transmit PDO.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	5	ro	yes
1	COB-ID	Unsigned 32	180h + Node ID	rw	yes
2	Transmission Mode	Unsigned 8	FE	rw	yes
3	Inhibit Time	Unsigned 32	0	rw	yes
4	Not available				
5	Event Timer	Unsigned 32	64h or 0	rw	yes

Object 1801h: 2nd Transmit PDO Communication Parameter

This object contains the communication parameter of the 2nd transmit PDO. NOTE: In the OCD versions C2 and C5 the second PDO was configured via object 1802!

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	5	ro	yes
1	COB-ID	Unsigned 32	280h + Node ID	rw	yes
2	Transmission Mode	Unsigned 8	1	rw	yes
3	Inhibit Time	Unsigned 32	0	rw	yes
4	Not available				
5	Event Timer	Unsigned 32	0	rw	yes

Transmission Mode

The transmission mode can be configured as described below:

Transfer Value (decimal)	Transmission Mode					Notes
	Cyclic	Acyclic	Synchronous	Asynchronous	RTR only	
0		X	X			Send PDO on first Sync message following an event
1-240	X		X			Send PDO every x Sync messages
241-251	reserved					

252			X		X	Receive SYNC message and send PDO on Remote Request
253					X	Update data and send PDO on Remote Request
254				X		Send PDO on event
255				X		Send PDO on event

Inhibit Time

For "Transmit PDOs", the "inhibit time" for PDO transmissions can be entered in this 16 bit field. If data is changed, the PDO sender checks whether an "inhibit time" has expired since the last transmission. A new PDO transmission can only take place if the "inhibit time" has expired. The "inhibit time" is useful for asynchronous transmission (transmission mode 254 and 255), to avoid overloads on the CAN bus.

Event Timer

The "event timer" only works in asynchronous transmission mode (transmission mode 254 and 255). If the data changes before the "event timer" expires, a temporary telegram is sent. If a value > 0 is written in this 16-bit field, the transmit PDO is always sent after the "event timer" expires. The value is written in subindex 5 of a transmit PDO. The data transfer also takes place with no change to data. The range is between 1-65536 ms.

Object 1A00h: 1st Transmit PDO Mapping Parameter

This object contains the mapping parameter of the 1st transmit PDO.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	2	ro	yes
1	1st mapped object	Unsigned 32	60040020h	rw	yes

Object 1A01h: 2nd Transmit PDO Mapping Parameter

This object contains the mapping parameter of the 2nd transmit PDO.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Number of sub indices	Unsigned 8	2	ro	yes
1	2nd mapped object	Unsigned 32	60040020h	rw	yes

Object 1F50h: Download Program Area

This is a special object that has functionality for the bootloader feature. (see Bootloader chapter)

Use this entry to download your Intel hex file with the programming data. Detailed information about Domain download and Block transfer in CiA Draft Standard 301 Application Layer and communication Profile.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	2h	ro	Yes
1h		DOMAIN		wo	yes

Object 1F51h: Program Control

This is a special bootloader object, to update the firmware (see Bootloader chapter).

This array controls the programs residing at index 0x1F50.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of program control entries	Unsigned 8	2h	ro	yes
1h		Unsigned 32		rw	yes

Sub-index 1h and higher control the memory block functionality. They can have the following values:

for writing:

1 - start downloaded program

4 - erase flash

Object 2000h: Position Value

This object contains the position value.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Position Value	Unsigned 32	-	ro	n.a.

Object 2100h: Operating Parameters

As operating parameters the code sequence (Complement) can be selected and the limit switches can be turned on or off.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Operating Parameters	Unsigned 8	0h	rw	yes

The parameter code sequence (Complement) determines the counting direction, in which the output process value increases or decreases (CW = Clockwise, CCW = Counterclockwise). The code sequence is determined by Bit 0 in Index 2100h. Additionally, the two limit switches, Min. and Max. can be turned on or off in Index 2100h. Optional an event triggered PDO can be activated. Remark: This function produces a PDO with every change of the position value. Due to this, there will be generated a large amount of PDOs and a heavy bus load.

Bit 0	Code sequence	Code	Bit 1	Limit switch, min.	Bit 2	Limit switch, max.	Bit 3	Event triggered PDO
0	CW	increasing	0	off	0	off	0	off
1	CCW	increasing	1	on	1	on	1	on

Calculation Example: Target: Absolute rotary encoder with direction CCW increasing, limit switch min enabled, limit switch max disabled and event-triggered PDOs enabled.

Bitmatrix:

Bit 0 = 1 Direction increasing CCW

Bit 1 = 1 Limit switch min. enabled

Bit 2 = 0 Limit switch max. disabled

Bit 3 = 1 Event triggered

Result = 1011b = Bh

Object 2101h: Resolution per Revolution

This object contains the desired steps per revolution of the encoder.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Resolution per Revolution	Unsigned 32	see type sign	rw	yes

If the desired value exceeds the hardware resolution of the encoder or is not a value of 2^n , it will be out of range. Only values in the power of two are valid, otherwise the error code “06090030h: Value range of parameter exceeded” will appear.

Object 2102h: Total Resolution

This object contains the desired total resolution of the encoder.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Total Resolution	Unsigned 32	see type sign	rw	yes

This parameter is used to program the desired number of measuring units over the total measuring range. This value must not exceed the total resolution of the absolute rotary encoder, which is printed on the type sign of the encoder.

Attention:

Following formula letter will be used:

PGA	Physical total resolution of the encoder	(see type sign)
PAU	Physical resolution per revolution	(see type sign)
GA	Total resolution (customer parameter)	
AU	Resolution per revolution (customer parameter)	

Please use the following formula to calculate the total resolution of the encoder:

$$GA = \frac{(PGA * AU)}{PAU}, AU \leq PAU \qquad k = \frac{PGA}{GA}, k = \text{ganze Zahl}$$

If the desired resolution per revolution is less than the really physical resolution per revolution of the encoder, then the total resolution must be entered as follows:

Total resolution:

Calculation example:
Customer handicap: AU = 2048
Encoder type sign:
PGA=24 bit, PAU=12bit

$$GA = \frac{(16777216 * 2048)}{4096}$$
$$GA = 8388608$$

If the total resolution of the encoder is less than the physical total resolution, the parameter total resolution must be a multiple of the physical total resolution:

Object 2103h: Preset Value

The preset value is the desired position value, which should be reached at a certain physical position of the axis. The position value is set to the desired process value by the parameter preset. The preset value must not exceed the parameter total resolution to avoid run-time errors. If the parameter value exceeds the total resolution of the encoder a SDO “Out of range” message is generated.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Preset Value	Unsigned 32	0	rw	yes

Object 2104h: Limit Switch, min.

Two position values can be programmed as limit switches. By reaching this value, one bit of the 32 bit process value is set to high. Both programmed values must not exceed the parameter total resolution to avoid run-time errors. If the parameter value exceeds the total resolution of the encoder a SDO “Out of range” message is generated.

Bit 30 = 1: Limit Switch, Min. reached or passed under

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Limit Switch, min.	Unsigned 32	0	rw	yes

The limit switch, Min sets Bit 30=1 with the next message telegram, if the process value reaches or passes under the value of the limit switch:

Function	Status bits		Process value																												
Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	0	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Object 2105h: Limit Switch, max.

Two position values can be programmed as limit switches. By reaching this value, one bit of the 32 bit process value is set to high. Both programmed values must not exceed the parameter total resolution to avoid run-time errors. If the parameter value exceeds the total resolution of the encoder a SDO “Out of range” message is generated.

Bit 31 = 1: Limit Switch, Max. reached or passed beyond

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Limit Switch, max.	Unsigned 32	0	rw	yes

The limit switch, max sets Bit 31=1 with the next message telegram, if the process value reaches or passes under the value of the limit switch:

Function	Status bits		Process value																												
Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	1	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Object 2160h: Customer storage

This object provides for the customer the possibility to store any value.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	4h	ro	
1h	Customer Storage1	Unsigned 32		rw	

2h	Customer Storage2	Unsigned 32		rw	
3h	Customer Storage3	Unsigned 32		rw	
4h	Customer Storage4	Unsigned 32		rw	

Object 2200h: Cyclic Timer PDO

This object contains cyclic time of the event timer in ms (of PDO 1).

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Event Time in ms	Unsigned 16	0h	ro	yes

The object 2200h is hard-wired to the objects 1800h subindex 5h and 6200h and provide the cycle time for the cyclic mode. (See chapter Cycle Time and Event Timer)

Object 2300h: Save Parameter with Reset

With this object all parameters can be stored in the non volatile memory. After storing the parameters a reset is executed.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Access code	Unsigned 32	55AAAA55h	wo	no

Object 3000h: Node Number

This object contains the node number of the device. The POSITAL standard node number is 32.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Node Number	Unsigned 8	1Fh	rw	Yes

NOTE: To avoid the node number 0, one will be added to the value of this object!
E.g.: 1Fh+1h = 20h = 32 (dec)

Object 3001h: Baudrate

This object contains the baudrate of the device.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0	Baudrate	Unsigned 8	-	rw	yes

Eight different baud rates are provided. To adjust the baud rate only one byte is used.

Baudrate in kBit/s	Byte
20	00h
50	01h
100	02h
125	03h
250	04h
500	05h
800	06h
1000	07h

Object 3010h: Speed Control

This object contains the speed control. The speed measurement is disabled by default.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	2h	ro	
1h	Enable Speed	Unsigned 8	0h	rw	yes
2h	Speed modus	Unsigned 8	0h	rw	yes

Object 3011h: Speed Value

This object contains speed value.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Speed value	Unsigned 8		romap	no

Object 3020h: Acceleration Control

This object contains the acceleration control. The acceleration measurement is disabled by default.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	2h	Ro	
1h	Enable Acceleration	Unsigned 8	0h	rw	Yes
2h	Acceleration modus	Unsigned 8	0h	rw	yes

Object 3021h: Acceleration Value

This object contains acceleration value.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Acceleration Value	INTEGER32		romap	

Object 4000h: Bootloader Control

This object controls the Bootloader functionality (see Bootloader chapter). Writing the security code to this object causes erasing the EEPROM and application information in the flash memory and resets the device. After a power-up, the Bootloader checks the user application and detects no more information. The Bootloader starts up with a pre-defined CANopen node ID of 1 (0x1) and a fixed CAN baud rate of 125 kbits.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Bootloader Control	Unsigned32		wo	

NOTE:

Activating the Bootloader courses a deep reset of the device. After this only a few objects are still available, the device does not behave like an encoder and waits for new programming. That is the reason why the security code is not published in this document. Please contact POSITAL to obtain the code.

Object 6000h: Operating parameters

This object shall indicate the functions for code sequence, commissioning diagnostic control and scaling function control.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Operating Parameter	Unsigned 16	1h	rw	yes

Code sequence: The code sequence defines, whether increasing or decreasing position values are output, in case the encoder shaft rotates clockwise or counter clockwise as seen from the point of view of the shaft.

Scaling function control: With the scaling function the encoder numerical value is converted in software to change the physical resolution of the encoder. The measuring units per revolution (object 6001h) and total measuring range in measuring units (object 6002h) are the scaling parameters. The scaling function bit is set in the operating parameters. If the scaling function bit is set to zero, the scaling function is disabled.

Bit structure for the operating parameters

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Use	MS	MS	MS	MS	R	R	R	R	R	R	R	R	MD	SFC	CD	CS

Table Description:

MS: Manufacturer Specific Function (not available)

R: Reserved for future use

MD: Measuring direction (not available)

SFC: Scaling function (0 = disable, 1 = enable)

CD: Commissioning diagnostic control (not availabe)

CS: Code sequence (0 = CW Up, 1 = CCW Up)

Code Sequence (CS Bit 0) is hardwired to Code Sequence (CS Bit 0) in object 2100h.

Object 6001h: Measuring units per revolution

This object shall indicate the number of distinguishable steps per revolution.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Measuring units per revolution	Unsigned 32	see type sign	rw	yes

Hardwired with 2101h.

Object 6002h: Total measuring range in measuring units

This object shall indicate the number of distinguishable steps over the total measuring range.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Total measuring steps	Unsigned 32	see type sign	rw	yes

Object 6003h: Preset value

This object indicates the preset value for the output position value

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Preset Value	Unsigned 32	0h	rw	yes

Object 6004h: Position value

This object contains the process value of the encoder.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Process Value	Unsigned 32	-	romap	yes

Hardwired with Object 2000h.

Object 6030h: Speed Value

This object contains the speed value of the encoder.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	1h	ro	
1h	Speed value channel1	Integer 16	-	romap	yes

If the velocity exceeds the data type, the speed value is frozen to the maximal possible value.
The customer can use the 3010h (32 bit) object.

Object 6040h: Acceleration Value

This object contains the acceleration value of the encoder.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	1h	ro	
1h	Acceleration value channel1	Integer 16	-	romap	yes

Object 6200h: Cyclic timer

This object contains the value of the event timer of the corresponding TPDOs. The value can be changed between 1-65538 ms.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Cyclic Time	Unsigned 16	64h	rw	yes

The object 6200h is hard-wired to the objects 1800h subindex 5h and 2200h and provide the cycle time for the cyclic mode. (See chapter Cycle Time and Event Timer)

Object 6300h: Cam state register

This object contains the cam state register. The subindices 1h to FEh contain the cam state of channel 1 to 254.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	1h	ro	
1h	Cam state channel 1	Unsigned 8	4h	romap	yes

Object 6301h: Cam enable register

This object contains the cam enable register

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	1h	ro	
1h	Cam enable channel 1	Unsigned 8		rw	yes

Object 6302h: Cam polarity register

This object contains the cam enable register

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	1h	ro	
1h	Cam polarity channel 1	Unsigned 8	0h	rw	yes

List of Cam objects						
6310h			Cam1 low limit		rw	
	0h	VAR	Highest sub-index supported	U32	ro	0x1
	1h	VAR	Cam1 low limit channel1		rw	
6311h			Cam2 low limit		rw	
	0h	VAR	Highest sub-index supported	U32	ro	0x1
	1h	VAR	Cam2 low limit channel1		rw	

6312h			Cam3 low limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam3 low limit channel1		rw	
6313h			Cam4 low limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam4 low limit channel1		rw	
6314h			Cam5 low limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam5 low limit channel1		rw	
6315h			Cam6 low limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam6 low limit channel1		rw	
6316h			Cam7 low limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam7 low limit channel1		rw	
6317h			Cam8 low limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam8 low limit channel1		rw	
6320h			Cam1 high limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam1 high limit channel1		rw	
6321h			Cam2 high limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam2 high limit channel1		rw	
6322h			Cam3 high limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam3 high limit channel1		rw	
6323h			Cam4 high limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam4 high limit channel1		rw	
6324h			Cam5 high limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam5 high limit channel1		rw	
6325h			Cam6 high limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam6 high limit channel1		rw	

6326h			Cam7 high limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam7 high limit channel1		rw	
6327h			Cam8 high limit		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam8 high limit channel1		rw	
6330h			Cam1 hyteresis		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam1 hyteresis channel1		rw	
6331h			Cam2 hyteresis		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam2 hyteresis channel1		rw	
6332h			Cam3 hyteresis		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam3 hyteresis channel1		rw	
6333h			Cam4 hyteresis		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam4 hyteresis channel1		rw	
6334h			Cam5 hyteresis		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam5 hyteresis channel1		rw	
6335h			Cam6 hyteresis		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam6 hyteresis channel1		rw	
6336h			Cam7 hyteresis		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam7 hyteresis channel1		rw	
6337h			Cam8 hyteresis		rw	
	0h	VAR	Highest sub-index supported	U8	ro	0x1
	1h	VAR	Cam8 hyteresis channel1		rw	

Object 6400h: Area state register

This object contains the area state register

The object provides the actual area status of the encoder position. Figure 9 specifies the object structure and Table 106 specifies the value definition.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Unsigned 8	1h	ro	
1h	Work area state channel	Unsigned 8		romap	yes

7	6	5	4	3	2	1	0
R	r	r	r	r	Range underflow	Range overflow	Out of range
MSB							LSB

Signal	Value	Definition
out of range	0 1	Position between low and high limit Position out of range (refer to module identification object, 650Ah) is reached
range overflow	0 1	No range overflow Position is lower than the position value set in object 6402h „work area low limit“
range underflow	0 1	No range underflow Position is higher than the position value set in object 6401h „work area high limit“
r	0	Reserved

Object 6401h: Work area low limit

This object indicates the position value, at which bit 2 of the according work area state channel in object 6400h shall flag the underflow of the related work area.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Integer 32	1h	ro	
1h	Work area low limit channel 1	Integer 32	0h	rw	yes

This object is hardwired with 2104h (Limit Switch Min).

Object 6402h: Work area high limit

This object indicates the position value, at which bit 1 of the according work area state channel in object 6400h shall flag the overflow of the related work area.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of sub indices	Integer 32	1h	ro	
1h	Work area high limit channel 1	Integer 32	0h	rw	yes

This object is hardwired with 2105h (Limit Switch Max).

Object 6500h: Operating status

This object shall provide the operating status of the encoder. It gives information on encoder internal programmed parameters.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Operating status	Unsigned 16	-	ro	no

The operating status object corresponds to the value of the object 6000h and 2100h.

Object 6501h: Single-turn resolution

The object contains the physical measuring steps per revolution of the absolute rotary encoder.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Single Turn Resolution	Unsigned 32	see type sign	ro	no

Object 6502h: Number of distinguishable revolutions

This object contains number of revolutions of the absolute rotary encoder.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Number of Revolutions	Unsigned 16	see type sign	ro	no

Object 6503h: Alarms

Additionally to the emergency messages in /CiA301/, this object shall provide further alarm messages. An alarm shall be set if a malfunction in the encoder could lead to incorrect position value. If an alarm occurs, the according bit shall indicate the alarm til the alarm is cleared and the encoder is able to provide an accurate position value.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Alarms	Unsigned 16	-	romap	no

Bit structure of the alarms

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Use	MS	MS	MS	MS	R	R	R	R	R	R	R	R	R	R	CD	PE

Table Description:

MS: Manufacturer Specific Alarm (not supported)

R: Reserved for future use

CD: Commissioning diagnostic control (not supported)

PE: Position Error (not supported)

Object 6504h: Supported alarms

The object shall provide the supported alarms of the device. Please refer to the bit structure table to find more details about the supported alarms.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Supported Alarms	Unsigned 16	1000h	ro	no

The CA-encoder supports the position error alarm.

Object 6505h: Warnings

This object shall provide the warnings. Warnings indicate that tolerance for certain internal parameters of the encoder have been exceeded. In contrast to alarm and emergency messages warnings do not imply incorrect position values. All warnings shall be cleared if the tolerances are again within normal parameters.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Warnings	Unsigned 16	-	romap	no

Bit structure of the warnings

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Use	MS	MS	MS	MS	R	R	R	R	R	R	RP	BC	OT	CP	LC	FE

Table Description:

MS: Manufacturer Specific Warnings (not supported)
R: Reserved for future use
RP: Reference Point reached/not reached (not supported)
BC: Battery charge (not supported)
OT: Operating Time limit (not supported)
CP: CPU watchdog status (not supported)
LC: Light control reserve (not supported)
FE: Frequency warning (not supported)

Object 6506h: Supported warnings

The object provides the supported warnings of the device. Please refer to the bit structure table to find more details about the supported warnings.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Supported Warnings	Unsigned 16	-1000h	ro	no

Currently there are not supported warnings available for an Optocode absolute rotary encoder.
The CA-encoder supports the manufacture specific warning (Bit 12).

Object 6507h: Profile and software version

This object provides the implemented encoder device profile version and the manufacturer-specific software version.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Profile and Software Version	Unsigned 32	04040302h	ro	no

The value is divided into the profile version part and the Software version part. Each part is divided in upper version and lower version.
MSB

LSB

Software Version 4.4		Profile Version 3.2	
Upper Software Version	Lower Software Version	Upper Profile Version	Lower Profile Version
04	04	03	02

Object 6508h: Operating time

This object indicates the operating time of the device. Currently the operating time is not supported and the value of this object will always be FFFFFFFFh.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Operatiung time	Unsigned 32	FFFFFFFFh	ro	no

Object 6509h: Offset value

This object contains the offset value. It is been calculated by the preset function and shifts the physical position value with the desired value.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Offset value	Integer 32	-	ro	no

Object 650Ah: Module identification

This object shall provide the manufacturer-specific offset value, the manufacturer-specific minimum and maximum position value.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Highest supported subindex	Integer 32	3	ro	no
1h	Manufacturer offset value	Integer 32	-	ro	no
2h	Man. min. position value	Integer 32	-	ro	no
3h	Man. max. position value	Integer 32	-	ro	no

Object 650Bh: Serial number

This object contains the serial number of the device. The serial number is also supported in object 1018h subindex 4h.

Subindex	Description	Data Type	Default Value	Access	Restore after BootUp
0h	Serial Number	Unsigned 32	See type sign	ro	no

6. Diagnosis

6.2 Troubleshooting

6.2.1 Power on – Encoder doesn't respond

Problem:
The bus is active but the installed encoder transmitted no boot up message.

Possible solution:

- The encoders have the default baud rate 20kbaud. Adapt your PLC setting accordingly.
- Reprogram the encoders baud rate
- Restart encoder so the new baud rate setting will be valid.

6.2.2 Malfunction of the position value during transmission

Problem:
During the transmission of the position value occasional malfunction occurs. The CAN bus can be temporary in the bus off state also.

Possible solution:
Check, if the last bus node has switched on the terminal resistor.

6.2.3 Too much ERROR-Frames

Problem:
The bus load is too high in case of too much error frames.

Possible solution:
Check if all bus node has the same baud rate. If one node has another baud rate error frames are produced automatically.

6.2.4 Limit switches without function

Problem:
The encoder didn't transmit the bits for the limit switches.

Possible solution:
The limit switch functionality has to be activated once. Please follow the description you can find at 4.5.

6.2.5 Baudrate and Node Number changes

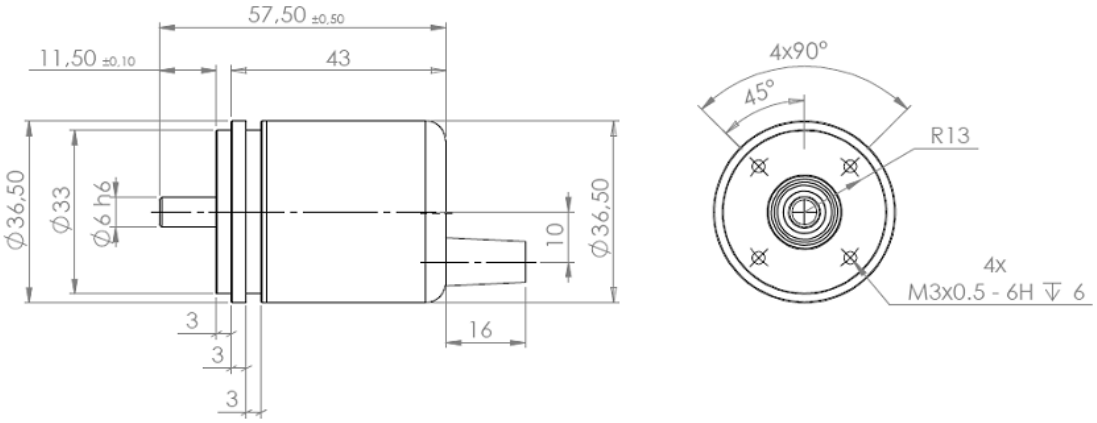
Notice: The changing of baud rate and node number are only valid after a new power up, NMT Reset or the store parameters command.

7. Mechanical Drawings

Synchro Flange (S)

Cable exit or

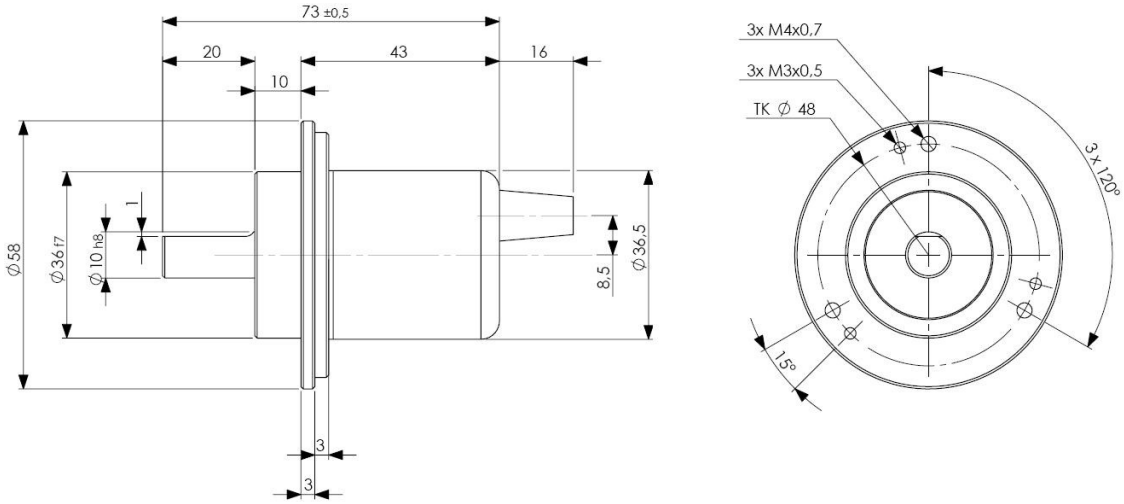
5 pin male M12 Connector



Clamp flange (C)

Cable exit or

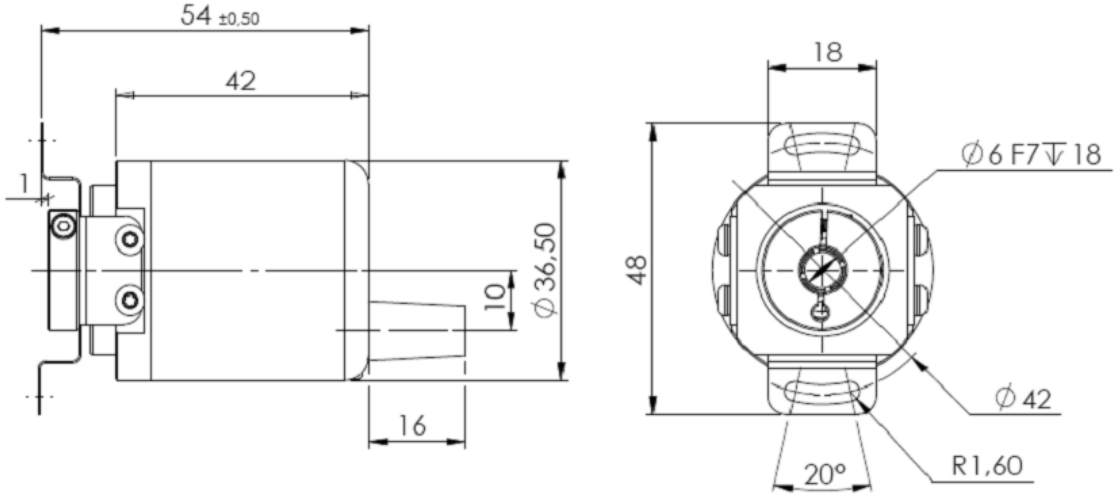
5 pin male M12 Connector



Hollow hollow shaft (B)

Cable exit or

5 pin male M12 Connector



Mounting instructions

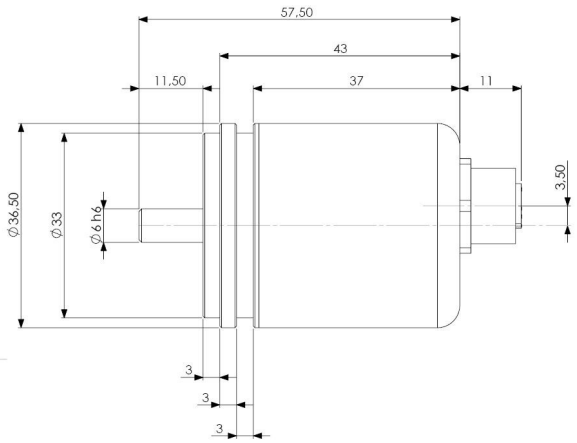
The clamp ring may only be tightened if the shaft of the driving element is in the hollow shaft.

Allowed shaft movements of the drive element are listed in the table.

	axial	radial
static	± 0.3 mm	± 0.5 mm
dynamic	± 0.1 mm	± 0.2 mm

5 pin male M12 Connector

Flange and housing dimensions from Synchro Flange



Appendix A: Order Codes

Remark: This table is only for your information and to find out what is the meaning of the type key on your encoder. For a valid type combination please refer to the corresponding datasheet or contact one of our distributors or Posital directly.

Description										
Magnetocode	**MCD-**	**C_**	**00**	**B**	__	__	_	__	_	__ _
Interface and Version	CANopen	**CA**								
	CANopen lift (DSP417)	CL								
Current Version	CA		**00**							
	CL		00							
Code	Binary			**B**						
Bits for Revolutions	Single turn				00					
	Multi turn (4.096 turns)				12					
	Multi turn (65.536 turns)				**16**					
Steps per revolution (Bits)	4.096					**12**				
Flange	Synchro flange						**S**			
	Blind hollow shaft						B			
	Clamp flange						C			
Shaft diameter	06 mm (Flange S and B)							**06**		
	10 mm (Flange C)							10		
Mechanical options	Without								**0**	
	Customized								C	
Connection	Cable exit, axial 1m									**CAW**
	Connector, axial, 5 pin male M12									PAM

Tab. 16 Order Key

Standard = bold, further models on request

Ordering example :

MCD-CA00B-1612-S060-CAW

Accessories and documentation

Description		Article Name	Article Number
Shaft Coupling	Drilling: 10 mm / 10 mm	GS 10	29100450
	Drilling: 6 mm / 6 mm	GS 06	29100350
	Drilling: 4 mm – 11 mm	GS 4-11	29100440

Appendix B: History

Appendix C: Glossary

A

Address	Number, assigned to each node, irrespective of whether it is a master or slave. The encoder address (non-volatile) is configured in the base with rotary switches or SDO objects.
APV	Absolute Position Value.

B

Baud rate	Transmission speed formulated in number of bits per second. Bus node Device that can send and/or receive or amplify data by means of the bus.
Byte	8-bit unit of data = 1 byte.

C

CAL	CAN application layer.
CAN	Controller Area Network or CAN multiplexing network.
CANopen	Application layer of an industrial network based on the CAN bus.
CCW	Counter-clockwise
CiA	CAN In Automation, organization of manufacturers and users of devices that operate on the CAN bus.
COB	Elementary communication object on the CAN network. All data is transferred using a COB.
COB-ID	COB-Identifier. Identifies an object in a network. The ID determines the transmission priority of this object. The COB-ID consists of a function code and a node number.
CW	Clockwise

E

EDS file	Standardized file containing the description of the parameters and the communication methods of the associated device.

F

FAQ	Frequently Asked Questions
FC Function code.	Determines the type of message sent via the CAN network.

L

Line terminator	Resistor terminating the main segments of the bus.
LMT	Network management object. This is used to configure the parameters of each layer in the CAN. Master "Active" device within the network, that can send data without having received a request. It controls data exchange and communication management.

N

NMT	Network management object. This is responsible for managing the execution, configuration and errors in a CAN network.
NN	Node number

P

PCV	Process Value
PDO	Communication object, with a high priority for sending process data.
PV	Preset Value: Configuration value

R

RO	Read Only: Parameter that is only accessible in read mode.
ROMAP	Read Only MAPable: Parameter that can be polled by the PDO.
RW	Read/Write: Parameter that can be accessed in read or write mode.

S

SDO	Communication object, with a low priority for messaging (configuration, error handling, diagnostics). Slave Bus node that sends data at the request of the master. The encoders are always slaves.

W

WO	Write Only: Parameter that is only accessible in write mode.

Appendix D: List of tables

Tab.1 Signal Assignment Connector / Cable 7
Tab. 2 Electrical Data 9
Tab. 3 Sensor data 9
Tab.4 Environmental Conditions 9
Tab. 5 Mechanical data 10
Tab. 6 Minimum Mechanical Lifetime 10
Tab.7 Cable properties 10
Tab. 8 CAN Transmission Mode Description 12
Tab. 9 List of Storable Parameters 13
Tab. 10 General Command Byte Description 15
Tab. 11 Detailed Command Byte Description 15
Tab. 12 Overview Object Dictionary 15
Tab. 13 Object Dictionary 1000h-1FFFh 17
Tab. 14 Object Dictionary 2000-5FFF 18
Tab. 15 Object Dictionary 6000h-6FFFh 19
Tab. 16 Order Key 52

Appendix E: Document history

Version	Date	Comment
02/09	03.02.09	Initial version